Fire in Yellowstone

Fire is a natural force operating in the Yellow-stone ecosystem since the beginning of time. Fire scars on old Douglas-fir trees in the Lamar River valley indicate an average frequency of one fire every 25 to 60 years. Even-aged stands of lodgepole pine throughout the park and charcoal in the soil indicate fire intervals of 200 years or more in these forests. Records kept since 1931 show that lightning starts an average of 22 fires each year.

The vegetation in the Greater Yellowstone Ecosystem has adapted to fire and in some cases is dependent on it. Some plant communities depend on the removal of the forest overstory to become established; they are the first to inhabit sites after a fire. Other plants growing on the forest floor are adapted to survive at a subsistence level for long periods of time until fires open the overstory.

Fire can limit trees in grasslands. Microhabitats suitable for tree seedling establishment are rare in a grassland, but if a seed reaches such a microhabitat during a favorable year, a tree may grow. Once the tree is growing, it begins to influence the immediate environment. More tree habitat is created and a small forest island eventually appears. Periodic fire kills the small trees before they have a chance to become islands, thus maintaining the grassland.

Older Douglas-fir trees are adapted to fire by having thick bark that resists damage by ground fires. In the past, in areas like the park's northern range, frequent ground fire kept most young Douglas-fir trees from becoming part of the overstory. The widely scattered, large, fire-scarred trees in some of the dense Douglas-fir stands in the valleys of the Lamar and Gardner rivers are probably remnants of these communities.

Lodgepole pines produce two types of cones, one of which opens after being heated to at least 113ºF. These fire-dependent cones—called serotinous—ensure seedling establishment after a fire. Lodgepole seedlings also need an open canopy that allows plenty of sun through. This happens only if mature trees in a lodgepole stand are periodically thinned by disease, fire, or other natural agents. Such disturbances create a landscape more diverse in age, which reduces the probability of disease or fire spreading through large areas.

Arthur Fire, 2002

Fire influences the rate minerals become available to plants by rapidly releasing these nutrients from wood and forest litter. Fire's heat may also hasten the weathering and release of soil minerals. Following a fire, plants rapidly absorb this abundant supply of soluble minerals.

Fire control alters these natural conditions. Landscape diversity diminishes, forest size increases, and plant community structure and composition change. Species susceptible to fires become prominent; diseases spread over greater areas; litter and deadfall accumulate; and minerals remain locked up or are more slowly released.

The expanses of even-aged lodgepole pine forests in Yellowstone are a good example of how fire—or lack of fire—affects this forest community.

FIRE ECOLOGY

- Fires have always occurred periodically in the Yellowstone ecosystem.
- Lightning starts an average of 22 fires each year.
- Vegetation in this ecosystem is adapted to fire.
- Controlling fires alters the dynamics of the ecosystem.

Effects of Fire Control

- *Vegetation diversity decreases as communities age.*
- *Species that do not benefit from fire are favored.*
- *Insects and diseases are more likely to spread.*
- *Litter and dead-fall accumulate, increasing chances of extreme fire behavior.*

6

Fire Management

History

- For the first 100 years of the park's existence, managers believed fires had to be extinguished to preserve park resources.
- Scientific research revealed:

—fires have occurred in Yellowstone for as long as there has been vegetation to burn

—fire plays a role in creating the landscape

—fire is a part of the ecosystem that park managers want to preserve

—suppressing fires alters the natural landscape and diminishes diversity.

- 1972, Yellowstone began using natural fire management.
- Between 1972 and 1987, 234 fires burned nearly 35,000 acres—mostly in two dry years, 1979 and 1981.
- The fires of 1988 brought about management changes (next section).

Current Fire Management Policy

The National Fire Plan emphasizes interagency cooperation in fire management. Appropriations for the plan include $101 million for National Park Service projects and activities identified in plan.

This four-wheel-drive fire truck was one of five that served Yellowstone from 1960 until 1996, including during the 1988 fires. The driver would head for the nearest river to refill the water tank.

Evolution of Fire Management

Fire suppression began with the arrival of the U.S. Army, which was placed in charge of protecting the park in 1886. The Army, which was in Yellowstone until 1918, successfully extinguished some fires, though it is difficult to determine what effect their efforts had on overall fire frequency or extent of fires. Their fire suppression was most effective on the northern range's grasslands. Reliable and consistent fire suppression began in the rest of the park when modern airborne firefighting techniques became available after World War II.

In 1972, Yellowstone was one of several national parks to initiate programs allowing some natural fires to run their courses. Two backcountry areas in the park (340,000 acres) were designated as locations where natural fires could burn.

In 1975, following initial successes of the program, an environmental assessment (EA) was prepared to expand the program to 1,700,000 acres in the park. It was approved early in 1976. Shortly thereafter Yellowstone National Park and Bridger–Teton National Forest entered into a cooperative program allowing naturally caused fires in the Teton Wilderness to burn across the boundary between the two federal units.

Yellowstone's fire management plan was gradually revised and updated in accordance with National Park Service guidelines and as research provided new information:

- Tens of thousands of lightning strikes simply fizzled out with no acreage burned.
- 140 lightning-caused fires burned only a small area.
- More than 80 percent of the lightning starts went out by themselves.
- A total of 34,175 acres burned in the park as a result of natural fires.
- The largest natural fire burned about 7,400 acres. (Prior to this, the largest natural fire in the park's written history was in 1931 at Heart Lake. About 18,000 acres burned.)

- No human lives were lost, and no significant human injuries occurred due to fires.
- No park structures or special features were affected.

By 1985, cooperative agreements were in place among all Greater Yellowstone units to allow natural fires to burn across the public land boundaries.

A fire plan revision was begun in late 1986 and was in the final stages of approval by spring 1988. The plan's goals:

- To permit lightning-caused fires to burn under natural conditions.
- To prevent wildfire from destroying human life, property, historic and cultural sites, special natural features, or threatened and endangered species.
- To suppress all human-caused fires (and any natural fires whose suppression is deemed necessary) safely, cost-effectively, and environmentally sensitive.
- To prescribe burn when and where necessary and practical to reduce hazardous fuels—primarily dead and down trees.

The plan was reviewed again after the fires of 1988 *(see next section)* when the Secretaries of the Departments of the Interior and Agriculture appointed a Fire Management Policy Review Team. Its final report, issued in May 1989, reaffirmed the basic soundness of natural fire policies in national parks and wilderness areas and offered 15 recommendations to improve federal fire management programs. These recommendations were incorporated into the National Park Service's Wildland Fire Management Policy Guideline revised in June 1990 and in the 1992 fire management plan revision in Yellowstone National Park.

National fire management plans continue to be reviewed after major fire seasons. For example, a major review of federal policies and programs followed the 1994 fire season when 34 people were killed in the western United States (none in Yellowstone, though). That review, completed in 1995, directs federal agencies to achieve a balance between suppression to protect life, property, and resources and "fire use" (the new term for natural fires that replaces prescribed natural fire) to regulate fuels and maintain healthy ecosystems. The report provides nine guiding principles and 13 policies to be incorporated into all wildland fire management actions.

Bringing water to the Arthur Fire

The National Fire Plan

During the 2000 fire season in the United States, almost 123,000 wildland fires burned more than 8.4 million acres and destroyed numerous structures. Subsequently, recommendations were developed on how to reduce the impacts of fire on rural communities and ensure sufficient firefighting resources for the future. That report, now known as the "National Fire Plan," identified five key points that continue to emphasize interagency approaches:

- *Firefighting: Continue to fight fires and be adequately prepared for the next year.*
- *Rehabilitation and Restoration: Restore landscapes and rebuild communities damaged by the wildfires of 2000.*
- *Hazardous Fuel Reduction: Invest in projects to reduce fire risk.*
- *Community Assistance: Work directly with communities to ensure adequate protection.*
- *Accountability: Be accountable and establish adequate oversight, coordination, program development, and monitoring for performance.*

The House and Senate approved an appropriations bill that included $101 million for National Park Service projects and activities identified in the National Fire Plan, including those in Yellowstone.

The principles include:

- Firefighter and public safety is the first priority.
- Wildland fire is an essential ecological process and a natural change agent and will be incorporated into the planning process.

These principles and policies were incorporated into wildland fire management activities for the 1996–2003 fire seasons.

6

The Fires of 1988

Statistics

- 9 fires caused by humans.
- 42 fires caused by lightning.
- 36% (793,880 acres) of the park was affected, mostly by surface burns.
- Fires begun outside of the park burned 63% or approximately 500,000 acres of the total acreage.
- About 300 large mammals perished as a direct result of the fires: 246 elk, 9 bison, 4 mule deer, 2 moose.
- $120 million spent fighting the fires.
- 25,000 people employed in these efforts.

Fighting the Fires

- Until July 15, naturally-caused fires allowed to burn.
- After July 15, all fires were fought, regardless of their cause.
- Single largest fire-fighting effort in the history of the United States to date.
- Effort saved human life and property, but probably had little impact on the fires themselves.
- Rain and snow in September finally stopped the advance of the fires.

Results of the Fires

- Extensive review, some revision of fire management policy *(see previous section).*
- Extensive research on fire ecology *(see next section).*

Moisture Content

When the moisture content of down and dead lodgepole pines is:

- *8 to 12%: lightning will start lots of fires & many will burn freely*
- *12 to 16%: some fires will burn up to 200 to 300 acres*
- *>16%: fires may start but few will burn any significant acreage*
- *24%: few fires start*

THE YEAR THE RAINS FAILED

Percent of Normal Rainfall
Mammoth Hot Springs

	April	May	June	July	Aug.
1977	10	96	63	195	163
1978	91	126	42	99	46
1979	6	17	42	115	151
1980	33	152	55	143	199
1981	49	176	102	103	25
1982	169	74	89	118	163
1983	22	29	69	269	88
1984	44	84	66	297	121
1985	42	93	44	160	84
1986	145	47	64	212	75
1987	42	144	75	303	122
1988	155	181	20	79	10

The spring of 1988 was wet until June, when hardly any rain fell. Park managers and fire behavior specialists expected that July would be wet, though, as it had been historically *(see chart below left).* About 20 lightning-caused fires were allowed to burn after evaluation according to the fire management plan. Eleven of these fires burned themselves out, behaving just like many fires had in previous years.

Rains did not come in July as predicted. By late July, after almost two months of little rain, moisture content of grasses and small branches reached levels as low as 2 or 3 percent, downed trees were as low as 7 percent (kiln-dried lumber is 12 percent). A series of unusually high winds fanned flames that even in the dry conditions would not have moved with great speed.

Because of the extremely dry conditions, after July 15 no new natural fires were allowed to burn. (Exceptions were made for natural fires that started adjacent to existing fires, when the new fires were clearly going to burn into existing fires.) Even so, within a week the perimeter of the fires in the park doubled to about 17,000 acres. After July 21, all fires were subjected to full suppression efforts as staffing would allow. (Human-caused fires had been vigorously suppressed from the beginning.) On July 27, during a visit to Yellowstone, the Secretary of the Interior reaffirmed that the natural fire program had been suspended, and all fires would be fought.

Fighting the Fires

An extensive interagency fire suppression effort was initiated in mid July in the Greater Yellowstone area in an attempt to control or contain the unprecedented series of wildfires. The extreme weather conditions and heavy, dry fuel accumulations presented even the most skilled professional firefighters with conditions rarely observed.

Accepted firefighting techniques were frequently ineffective because fires spread long distances by "spotting," a phenomenon in which wind carries embers from the tops of the 200-foot flames far out across unburned forest to start spot fires well ahead of the main fire. Regular spotting up to a mile and a half away from the fires made the widest bulldozer lines useless and enabled the fires to jump rivers, roads, and even the Grand Canyon of the Yellowstone River.

Fires often moved two miles per hour, with common daily advances of five to ten miles, consuming even very light fuels that would have been unburnable during an average season. The fast movement, coupled with spotting, made frontal attacks on the fires impossibly dangerous, as fire crews could easily be overrun or trapped between a main fire and its outlying spot fires. Even during the night, fires could not be fought. Normally, wildfires "lie down" at night as increased humidity and decreased temperature quiet them. But in 1988, the humidity remained low at night, and fire fighting was further complicated by extreme danger from falling trees.

Firefighting efforts were directed at controlling the flanks of fires and protecting lives and property in their paths. The fire experts on site generally agreed that only rain or snow could stop the fires. They were right: one-quarter inch of snow on September 11 stopped the advance of the fires.

By the last week in September, about 50 lightning-caused fires had occurred in or burned into the park, but only eight were still burning. More than $120,000,000 had been spent in control efforts on fires in the greater Yellowstone area, and most major park developments—and a few surrounding communities—had been evacuated at least once as fires approached within a few miles. The fire suppression efforts involved many different federal and state agencies, including the armed forces. At the height of the fires, ten thousand people were involved. This was the largest such cooperative effort ever undertaken in the United States.

Confusion in the Media

The Yellowstone area fires of 1988 received more national attention than any other event in the history of national parks. Unfortunately, many media reports were inaccurate or misleading and confused or alarmed the public. The reports tended to lump all fires in the Yellowstone area together as the "Yellowstone Park Fire"; they referred to these fires as part of the park's natural fire program, which was not true; and they often contained oversimplification of events and exaggeration of how many acres had burned. In Yellowstone National Park itself, the fires affected—but did not "devastate"—793,880 acres or 36 percent of the park's total acreage.

The North Fork Fire threatened Old Faithful, Madison, Canyon, Norris, West Yellowstone, Mammoth Hot Springs, and the Tower–Roosevelt area.

A number of major fires, most notably the North Fork Fire, the Hellroaring Fire, the Storm Creek Fire, the Huck Fire, and the Mink Fire started outside the park. These fires accounted for more than half of the total acres burned in the greater Yellowstone area, and included most of the ones that received intensive media attention. The North Fork Fire began in the Targhee National Forest and suppression attempts began immediately. The Storm Creek Fire started as a lightning strike in the Absaroka–Beartooth Wilderness of the Custer National Forest northeast of Yellowstone; it eventually threatened the Cooke City–Silver Gate area, where it received extended national television coverage.

Additional confusion resulted from the mistaken belief that managers in the Yellowstone area let park fires continue burning unchecked because of the natural fire plan—long after such fires were being fought. Confusion was probably heightened by misunderstandings about how fires are fought: if crews were observed letting a fire burn, casual observers might think the burn was merely being monitored. In fact, in many

Burned Area Within Yellowstone National Park

Burn Type	Acres	Percent of Park
• Crown fire: consuming the forest canopy, needles, and ground cover and debris	323,291	15%
• Mixed: mixture of burn types in areas where most of ground surface was burned	281,098	13%
• Meadows, sagebrush, grassland	51,301	2%
• Undifferentiated: variety of burn types	37,202	2%
• Undelineated: surface burns not detectable by satellite because under unburned canopy	100,988	4%
Total Burned Area	**793,880**	**36%**
Total Unburned Area	**1,427,920**	**64%**

Data from the Geographic Information Systems Laboratory, Yellowstone National Park, 1989; Table adapted from Yellowstone in the Afterglow: Lessons From the Fires, *Mary Ann Franke, 2000.*

instances, fire bosses recognized the hopelessness of stopping fires and concentrated their efforts on the protection of buildings and developed areas.

The most unfortunate public and media misconception about the Yellowstone firefighting effort may have been that human beings can always control fire. These fires could not be controlled; their raw, unbridled power cannot be overemphasized. Firefighters were compelled to choose their fights very carefully, and they deserve great praise for working so successfully to save all but a few of the buildings in the park.

Post-fire Response and Ecological Consequences

By late September, as the fires were diminishing, plans were underway in Yellowstone to develop comprehensive programs for all aspects of post-fire response. These included replacement, rehabilitation, or repair of damaged buildings, power lines, firelines, trails, campsites, and other facilities. Similarly, programs were developed to interpret the fires and their effects for visitors and for the general public. The park also cooperated with other agencies and state and local governments in promoting the economic recovery of communities near the park that were affected by the fires.

The same scene in 1988 after the fires (left) and in 1989 (right)

Scientists wanted to monitor the ecological processes following these major fires. The National Park Service cooperated with other agencies and independent researchers and institutions in developing comprehensive research directions for this unparalleled scientific opportunity.

Observations began while the fires were still burning, when it was apparent that the fires did not annihilate all life forms in their paths. Burning at a variety of intensities, sometimes as ground fires, sometimes as crown fires, the fires killed many lodgepole pines and other trees, but did not kill most other plants; they merely burned the tops off of them, leaving roots to regenerate.

Temperatures high enough to kill seeds occurred in less than one-tenth of one percent of the park. Only under logs and in deep litter accumulations, where the fire was able to burn for several hours, did lethal heat penetrate more deeply into the soil. Where water was available, new plant growth began within a few days. In dry soils, the rhizomes, bulbs, root crown, seeds, and other reproductive tissues had to wait until soil moisture was replenished the following spring.

The fires of 1988 created a mosaic of burns, partial burns, and unburned areas that are now the new habitats of plants and animals. This mosaic actually provides natural firebreaks, reducing the number of fire starts and limiting fire size over time while sustaining a greater variety of plant and animal species. Vegetation capable of sustaining another major fire will be rare for decades, except in extraordinary situations.

Though animal movements were sometimes affected dramatically by the passage of fires, relatively few animals died. However, portions of the northern range burned, which affected winter survival of grazing animals when coupled with summer drought conditions. In this and many other ways, fires dramatically altered the habitat and food production of Yellowstone for the short term.

Yellowstone Fires 1988–2003

	Number of Fires		
Year	Prescription	Suppressed	Acres Burned
1988	*	45	793,880
1989	*	24	10
1990	*	43	247
1991	*	29	270
1992	15	14	485
1993	5	5	<1
1994	4	60	16,343
1995	9	7	3
1996	13	11	3,263
1997	12	1	<1
1998	11	2	125
1999	11	4	10
2000	2	31	7,209
2001	16	21	7,987
2002	8	38	12,755
2003	7	71	28,849

* After the natural fire policy was suspended on July 15, 1988, all fires in the park were suppressed until the revised policy was approved in 1992.

Table adapted from Yellowstone in the Afterglow: Lessons From the Fires, *Mary Ann Franke, 2000.*

More wildland fire statistics at www.nifc.gov

6

Results of Fire Research Since 1988

In 2000, The Yellowstone Center for Resources published Yellowstone in the Afterglow: Lessons from the Fires, *by Mary Ann Franke. Some findings are summarized on the next four pages.*

What Has Changed

Although some long-term consequences of the fires remain to be seen, these changes have been caused entirely or in part by the fires of 1988:

- ✓ The replacement of thousands of acres of forest with standing or fallen snags and millions of lodgepole pine seedlings.
- ✓ The establishment of aspen seedlings in areas of the park where aspen had not previously existed.
- ✓ A decline in the moose population because of the loss of old growth forest.
- ✓ Shifts in stream channels as a result of debris flows from burned slopes.
- ✓ An increase in the public understanding and acceptance of the role of fire in wildland areas.
- ✓ A stronger program to reduce hazardous fuels around developed areas.

What Has *NOT* Happened Since 1988

Whether you agree that Yellowstone became "a blighted wasteland for generations to come," as announced by one U.S. Senator in 1988, is a matter of personal opinion. But of the more quantifiable predictions that were made about the fires' long-term consequences, there is not yet any evidence that the following have come to pass:

- ✗ A long-term drop in park visitation.
- ✗ Flooding downstream of the park because of increased runoff on bare slopes.
- ✗ A decline in fish populations because increased erosion silts up the water.
- ✗ An increase in fish populations in smaller streams where deforestation and loss of shade could result in warmer water and higher nutrient levels.
- ✗ More rapid invasion of non-native plants into burned areas and corridors cleared as fire breaks.
- ✗ An increase in lynx following a boom in snowshoe hares as a result of changes in forest structure.
- ✗ Increased willow vigor and production of the defense compounds that deter its browsing by elk and moose.
- ✗ An increase in the elk population because of improved forage.
- ✗ A decline in the endangered grizzly bear population because of smaller whitebark pine seed crops.
- ✗ Another big fire season in Yellowstone because of all the fuel provided by so many dead and downed trees.
- ✗ Adoption of a program of prescribed burning to reduce the likelihood of future large fires in Yellowstone.

6

Results of Fire Research Since 1988

Soils

Fertile soils with good water-holding capacity that had a dense, diverse vegetation before the fire were likely to respond quickly after the fire with a variety of species and nearly complete cover. Some soils in Yellowstone supported little vegetation before the fires and have continued to have little since then. Areas that appear barren and highly erosive did not necessarily become that way because of fire.

Vegetation

As root systems of standing dead trees decay and lose their grip on the soil, the trees are gradually falling down, often with the help of a strong wind. However, many will remain upright for another decade or more.

Many of the forests that burned in 1988 were mature lodgepole stands, and this species is now recolonizing most burned areas. The first seedlings of Engelmann spruce, subalpine fir, and Douglas-fir are also beginning to emerge.

The density of lodgepole pine seedlings in burned areas after the 1988 fires varied, depending on factors such as fire severity, elevation, abundance of serotinous cones, and seedbed characteristics. Density ranged from 80 seedlings per hectare in a high-elevation stand with no serotinous cones to 1.9 million seedlings per hectare in a low-elevation stand in which nearly half the trees had serotinous cones. (One hectare is approximately 2.5 acres.)

About 28 percent of the park's whitebark pine forest burned in 1988. This affects grizzly bears, for which whitebark pine seeds are an important food in fall. Seeds not consumed by grizzlies remain in caches of red squirrels and Clark's nutcracker. These buried seeds and the hardiness of whitebark pine seedlings on exposed sites give this tree an initial advantage in large burned areas over conifers that depend on the wind to disperse their seeds. However, this slow-growing and long-lived tree is typically more than a century old before it begins producing cones. The young trees may die before reproducing if the interval between fires is too short or if faster-growing conifers overtake them. By 1995, whitebark pine seedlings had appeared in all 275 study plots, though density was not significantly different between burned and unburned sites.

About one-third of the aspen in the northern range burned in the 1988 fires—but the aspen stands were not destroyed. Fire that killed individual adult trees also enhanced aspen reproduction. Like other disturbances, fire stimulates the growth of suckers from the aspen's extensive underground root system. (Suckers and root shoots produce clones of the "parent" aspen.) Fire also leaves behind bare mineral soil devoid of taller plants—perfect conditions for aspen seedlings. After the fires of 1988, aspen seedlings appeared throughout the park's burned areas. All the young trees, whether clones or seedlings, can be heavily browsed by elk and may not grow much beyond shrub height. But the fires indirectly helped protect some of these young trees: the trunks of fallen trees keep elk from reaching some of the young aspen.

Like trees, most other types of vegetation in the park were not killed by the fires; the portion above ground may have been burned off, but the roots were left to regenerate. The regrowth of plant communities began as soon as the fire was gone and moisture was available, which in some sites was within days. In dry soils, the seeds had to wait until moisture was replenished the following spring. New seedlings grew even in the few areas where

Some grasses and flowers, such as fireweed (above), thrived only in the first years after the fires, while others such as pinegrass and showy aster have slowly but steadily increased.

6

Results of Fire Research Since 1988

Fifteen years after the fires, the moose is the only large mammal whose population appears to have declined because of the fires. Willow and subalpine fir—winter food for moose—were reduced by the fires. Dense forest canopies were also gone, so snow accumulated more deeply. The combination of less food and deeper snow contributed to increased winter moose mortality.

the soil had burned intensely enough to become sterilized. Within a few years, grasslands had largely returned to their pre-fire appearance, and sagebrush areas may be next, in another 20 to 30 years.

Plant growth was unusually lush in the first years after the fires because of the mineral nutrients in the ash and increased sunlight on the forest floor. Moss an inch or more thick became established in burned soils, and may have been a factor in moisture retention, promoting revegetation and slowing erosion.

Wildlife

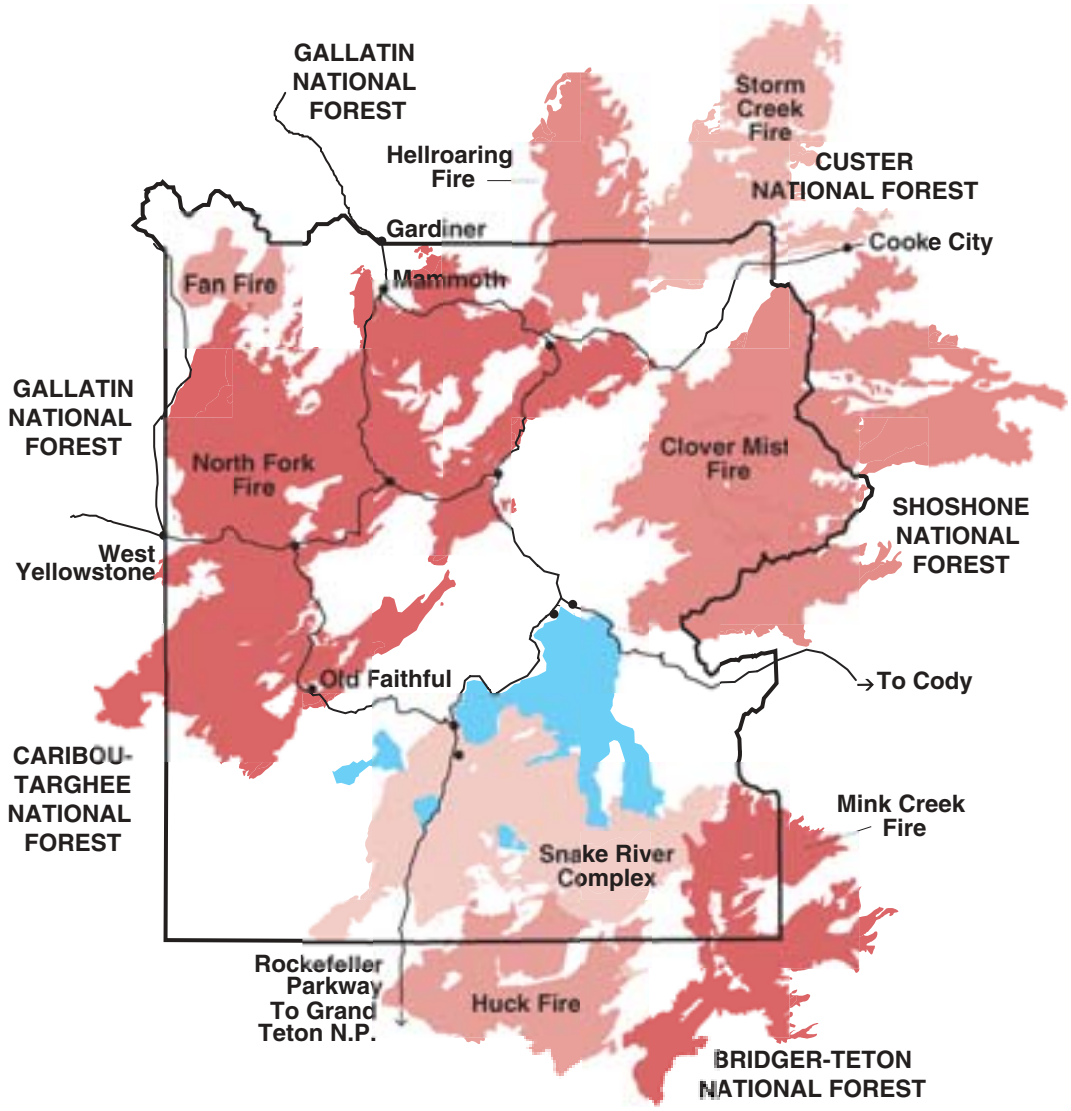
Most ungulate (hoofed) species were more affected by the drought and the relatively severe winter that followed than by the fires themselves. Although none of their winter range burned, mule deer declined 19 percent and pronghorn 29 percent during the winter of 1988.

Elk mortality rose to about 40 percent in the winter of 1988–89, but scientists are unsure how much of this was due to reduced forage because of the fires. (At least 15 percent of the deaths were due to the hunting season outside the park.) Even without the fires, several factors would probably have led to high elk mortality that winter; summer drought, herd density, hunting harvest, and winter severity. The greatest impact of the fires would therefore be on the quantity and quality of forage available to elk in subsequent years. A two-year study following the fires found that the forage quality of three types of grasses was better at burned sites than unburned sites.

Of the 38 grizzly bears wearing radio transmitters when the fires began, 21 had home ranges that were burned by one or more of the fires: 13 of these bears moved into burned areas after the fire front had passed, three bears (adult females without young) stayed within active burns as the fire progressed, three bears remained outside the burn lines at all times, and two adult females could not be located. In a study from 1989–92, bears were found grazing more frequently at burned than unburned sites, especially on clover and fireweed. Even though bear feeding activity in some whitebark pine areas decreased as much as 63 percent, the fires have had no discernable impact on the number of grizzly bears in greater Yellowstone.

Rodents probably had the highest fire-related mortality of any mammals. Although many could escape the fires in burrows, others died of suffocation as the fires came through. They also were more exposed to predators because they had lost the cover of grasses and other plants. But if the number of small mammals did temporarily decline while their predators multiplied, the increased number of predators would soon face a food shortage themselves, continuing the ongoing adjustment in the predator-prey ratio.

Most birds were not directly harmed by the fires and some benefited. For example, raptors hunted rodents fleeing the fires. But young osprey that were still in their nests



The 1988 fires affected—but did not necessarily burn—thousands of acres. Many of the effects were positive, as research since that time has shown.

died. Post-fire habitat changes helped some birds. Cavity-nesting birds, such as Barrow's goldeneye, flickers, and bluebirds, had many dead trees for their nests. Robins and flickers found ants and worms more easily. Boreal owls, however, lost some of the mature forests they need.

Aquatic Resources

In general, the amount of soil loss and sediment deposits in streams varied greatly, but in most cases was within the normal range.

About a quarter of the Yellowstone Lake and Lewis Lake watersheds and half of the Heart Lake watershed burned to some extent, but no significant changes have been observed in nutrient enrichment, plankton production, or fish growth as a result. There was no apparent increase in streambank erosion or change in substrate composition or channel morphology that would affect cutthroat trout spawning habitat, nor does there appear to have been a decline in the number of spawning streams. No discernible fire-related effects have been observed in the fish populations or the angling experience in the six rivers that have been monitored regularly since 1988.

In other park watersheds, such as the Gibbon River, massive erosion and mudslides occurred during and after the heavy rains of the summer of 1989. Scientists don't know how much the fires of 1988 facilitated these events. However, by 1991, growth of plants had slowed this erosion.

Conclusion

In the years since the fires, visitors have marveled at the new vistas, the wildflower blooms, and the lush growth of new, young trees. Some visitors still feel that the Yellowstone they knew and loved is gone forever. But Yellowstone is not a museum—it is a functioning ecosystem in which fire plays a vital role.

6

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www.fire.nps.gov for information about the National Fire Plan

Additional Information from Yellowstone National Park

Yellowstone National Park website, www.nps.gov/yell, includes an array of park information about resources, science, recreation, and issues.

Yellowstone Science, published quarterly, reports on research and includes articles on natural and cultural resources. Free; available from the Yellowstone Center for Resources, in the Yellowstone Research Library, or online at www.nps.gov/yell.

Yellowstone Today, published seasonally and distributed at entrance gates and visitor centers, includes features on park resources such as hydrothermal features.